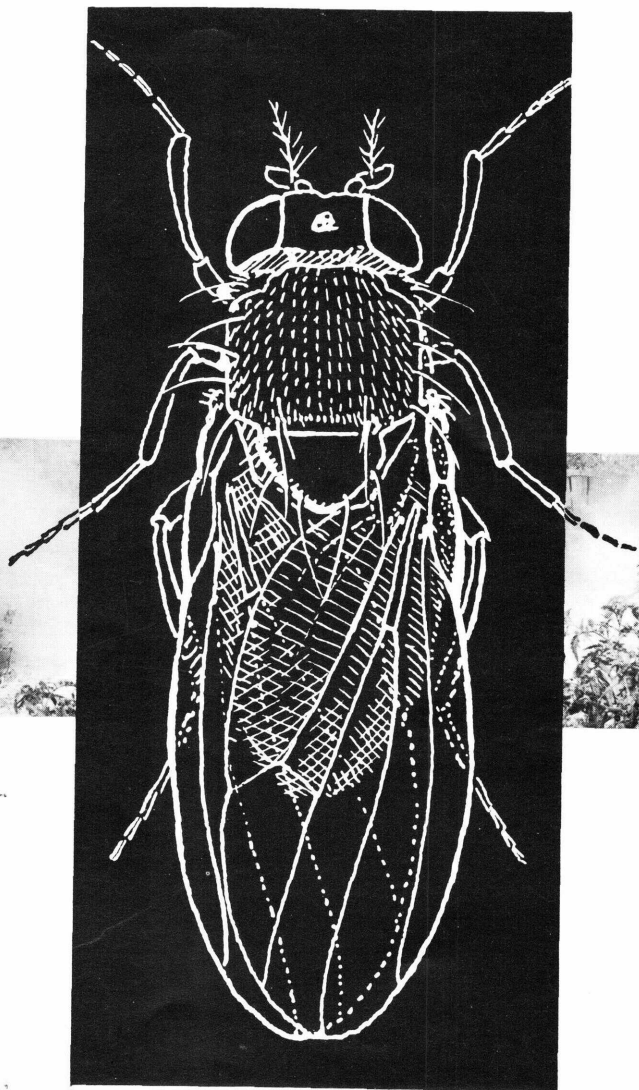
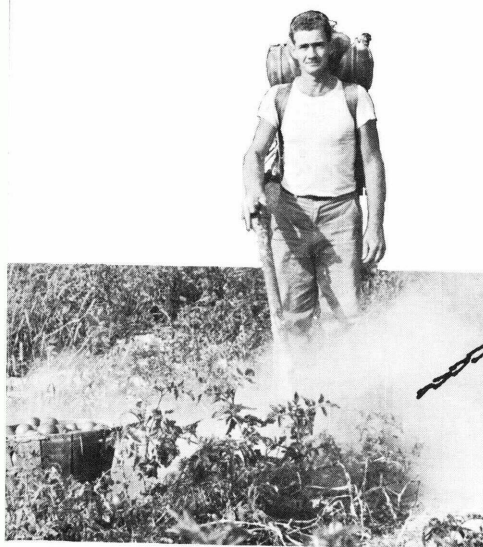


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Controlling Drosophila Flies on Tomatoes Grown for Canning



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Controlling *Drosophila* Flies On Tomatoes • Grown for Canning



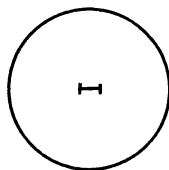
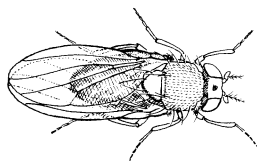
By HORATIO C. MASON and HOWARD E. DORST, *Entomology Research Division,
Agricultural Research Service*

Drosophila flies are a greater menace to the tomato processing industry than any other insect. They cause heavy losses each year by contaminating tomato products with their eggs and young. Such contaminated products are considered unfit for food, and are subject to condemnation.

Several species of *drosophila* flies infect tomatoes; the one usually prevalent has the scientific name *Drosophila melanogaster*. These flies are also known by their common name, vinegar flies, and are sometimes called vinegar gnats, pomace flies, sour flies, sour gnats, or banana flies. They often are mistakenly called fruit flies, but they are much smaller. Unlike fruit flies, they do not break the skins of sound produce. They normally attack only fruit or produce that has fresh cracks or breaks containing free juice.

Drosophila flies breed freely in

many kinds of organic matter, especially in certain ripe fruits and vegetables. Ripe tomatoes that have fresh cracks or breaks are highly attractive to the female flies as depositories for their eggs, and are good media for larval development. If culls and refuse of tomatoes, melons, peaches, or other fruits are allowed to accumulate, an enormous population of adult *drosophila* flies can develop in a short time and become a serious menace in the fields or around the canning plant.



BN-14210

***Drosophila* fly, greatly enlarged.
Line in circle shows actual length.**

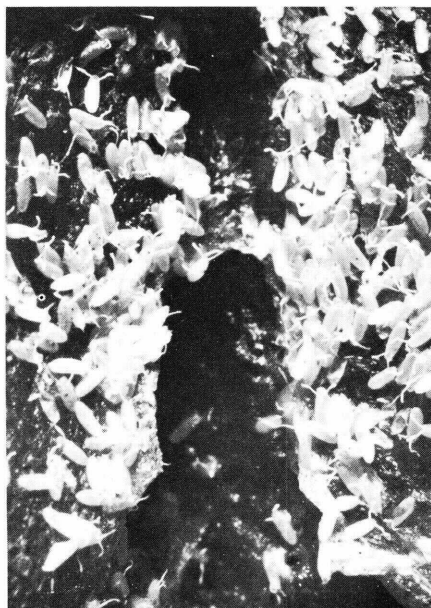
DEVELOPMENT

Adults.—The adult of the *melanogaster* species is a transparent-winged fly, about $\frac{1}{10}$ inch long. The body is yellowish, and the abdomen is crossed by dark bands. Females lay their eggs in fresh cracks or breaks in ripe tomatoes. Egg laying starts about the second day of adult life and may continue for several weeks at the rate of 25 eggs or more each day; a female fly has been known to lay as many as 2,000 eggs during her life. The life span for both sexes is longer where temperatures are lower (closer to 65° F. than to 85°).

Eggs.—The eggs are pearly white, elongate, and about $\frac{1}{50}$ inch long. Eggs of *melanogaster* have two appendages or filaments attached near the head end. Eggs of other species may be slightly longer and have two to four appendages.

Individual eggs are too small to be seen easily by the unaided eye; when present in large numbers in cracks in fruit, they resemble white mold. Eggs usually are laid with their appendages or filaments above the surface of the media in which they are placed. They hatch into larvae in about 24 hours.

Larvae.—The larvae, or maggots, may be quite transparent, or they may appear to be cream colored or some other shade caused by food in the gut. When first hatched, larvae are not easily seen without aid of a magnifying glass. They complete development in about 4 days when the temperature is near 77° F., and may measure about $\frac{1}{5}$ inch



TC-5548

Drosophila eggs in fresh crack in tomato, greatly enlarged.

long when fully grown. When mature, they seek a relatively dry place to pupate.

Pupae.—The pupae are about $\frac{1}{8}$ inch long. At first they are yellowish white, then turn amber and finally turn brown within a few hours. The anterior end of a pupa is broader and flatter than the posterior end, and has two stalklike structures that bear the respiratory organs.

The pupal period lasts about 5 days; during this time the pupa transforms into an adult fly.

Life Cycle.—Development from adult to adult may be completed in about 10 days at a temperature near

77° F., and in about 8 days at a temperature near 85°.

Overwintering Habits

Little is known about the overwintering habits of drosophila flies in northern climates. In the Washington, D.C., area, these flies have been observed during the winter in great numbers around markets where large quantities of produce were being handled. Observations in New Jersey indicate that the flies may breed throughout winter in plant products, in places such as sweetpotato houses and root cellars. In Utah and western Colorado, the insects have been observed passing the winter as pupae or larvae in protected areas where relatively dry, decaying, fermented plant material was available.

Factors Influencing Development

Rainy, cloudy periods during the

harvest season cause lower temperatures and induce cracking of ripe fruit. Such weather is more favorable for the development of drosophila flies than is hot, dry, sunny weather. Investigators at the Maryland Agricultural Experiment Station found that the temperature of fruit exposed to the sun on a hot day may reach 125° F. or higher; this is sufficient to kill the larvae.

Strong winds, high or low temperatures, and bright light retard fly activity. Little egg-laying activity occurs at temperatures above 90° F. or below 55°. Light intensity most favorable for the flies is about equivalent to that occurring near sundown.

The flies usually are more active in the morning and late afternoon. During the heat of the day, they seek shelter in the shade of rank tomato vines and in grass and weeds. They may remain active throughout cloudy days.

CONTROL

No single operation will give satisfactory control of drosophila flies. Control in the field or at the cannery or receiving station can be obtained by using a combination of well coordinated measures. The control program will be more effective if it is supported by community-wide effort. Control measures

may be classified as *operational practices* and *use of insecticide*.

Control in the Field

Operational Practices

When possible, do not locate tomato fields near peach orchards or melon fields unless all cull fruits and melons are to be disposed of

promptly. Do not locate tomato fields near fruit or sweetpotato storage houses, or near places where organic refuse is deposited. *Drosophila* flies coming from these places can infest your tomatoes.

Grow a good variety of canning tomatoes that is crack resistant. Ripe tomatoes that have fresh cracks attract egg-laying flies.

If feasible, space your tomato rows far enough apart to minimize the crushing of fruit during picking and other operations; this spacing may not be advisable if it intensifies other problems such as curly top on tomatoes in Utah and Colorado.

Keep fields free from weeds and grass. Vegetative growth provides shade and lower temperatures for the flies during hot weather; it encourages egg laying.

Provide bare driveways in the field, preferably running across the rows, at convenient distances for placing filled containers and for

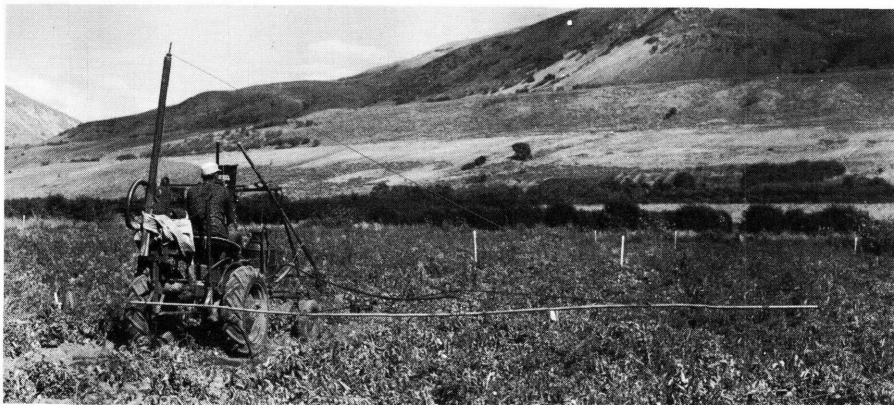
loading trucks. This will also reduce crushing of fruit.

Do not delay the first picking. Harvest frequently thereafter, to prevent the accumulation of over-ripe, cracked tomatoes.

Remove tomatoes from the field as soon as possible after harvesting. Never leave them in the field overnight; late afternoon and early morning are the times most favorable for flies to lay eggs on them.

Do not be careless or rough in handling tomatoes during or after harvesting. Do not overfill baskets or boxes. Take care not to crush the fruit when stacking or loading filled containers. These handling precautions are very important. A basket of tomatoes containing several crushed fruits, exposed to a high population of flies, may become infested with thousands of eggs during the period between harvesting and processing.

Use clean, dry containers for harvesting the fruit, and clean trucks



TC-5549

Spraying tomatoes with tractor sprayer that has a 20-foot boom.

for delivery from the field to the receiving station or cannery. Fresh tomato residues in containers or trucks will attract the flies.

Use of Insecticide

Use of insecticide to control drosophila flies in the field is an important part of the control program.

When to apply insecticide.—Applications should start as soon as the flies are present in the field. Their presence may be detected by the slit-tomato test, as follows:

In each of several ripe tomatoes, make two vertical slits about 1½ inches long; make one slit on one side and another slit on the opposite

side of the fruit; do not cut through the wall of the tomato. Squeeze the tomato enough to slightly open the slits and free some juice. At about 4 p.m., place one of the slit tomatoes at each of several random locations in the tomato field, under the vines. Collect them about 9 the following morning and examine the slits under a magnifying glass. If eggs are present, start insecticide applications.

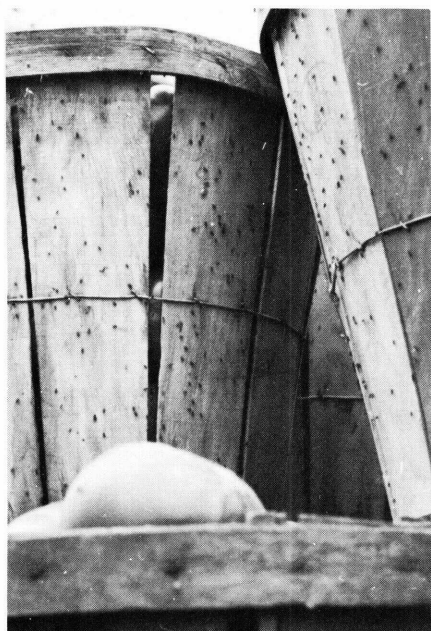
The first slit-tomato test should be made at the time of the first picking, and should be repeated at about 5-day intervals until eggs are found. Once started, insecticide applications should be repeated at 4- or 5-day intervals as long as the presence of drosophila flies or eggs indicate that control is needed. Time applications to take advantage of the minimum waiting period required between application and harvest.

Field applications of insecticide will destroy a large number of drosophila flies, but cannot be relied on to give adequate control under adverse conditions. Field applications should be made as part of the integrated control program described in this publication.

What insecticide to apply.—For field application to the plants, use one of the following materials, as indicated:

- *Diazinon*, ¾ pound of active ingredient per acre in a spray or dust, or 1 pound per acre in granules; or

- *Malathion*, 2 pounds of active ingredient per acre in a spray or in granules; or



TC-5551

Drosophila flies on baskets of tomatoes before delivery to the cannery.



TC-5550

Applying granular insecticide with a cyclone hand seeder.

● *Aldrin*, $\frac{1}{2}$ pound of active ingredient per acre in a spray, dust, or in granules.

How to apply.—Any of these formulations may be applied with power equipment. If you do not have power equipment that will apply granular formulations, you may use hand seeders to treat considerable acreage. If you use a spray, apply it at the rate of 50 to 200 gallons per acre.

Protecting harvested tomatoes.—To reduce the number of *drosophila*

OTHER CONTROLS

Important to the *drosophila* control program is the control of tomato diseases and other insects such as grasshoppers, beetles, fruitworms, and hornworms. By these additional controls, you can reduce the amount of damaged fruit that accumulates in the field to attract *drosophila* flies.

eggs laid on harvested tomatoes, dust the baskets or boxes of fruit with a freshly mixed, stabilized pyrethrum dust containing 0.1 percent of pyrethrins and 1.0 percent of piperonyl butoxide. This dust may be formulated with pyrophyllite, talc, walnut-shell flour, or volcanic dust that is neutral or slightly acid. If flies are present, apply the dust during harvest or immediately after harvest. Repeat the application in about 12 hours if the tomatoes are not processed the same day they are picked.

Do not hold harvested tomatoes overnight without dusting with pyrethrum. You will obtain better penetration and coverage if you apply the dust before the tomatoes are stacked. A knapsack power duster is very satisfactory for post-harvest treatment. Good coverage of the fruit is important for success of this treatment.

Pickers may treat the tomatoes during harvest by applying two to four puffs of dust to each basket or box when it is about $\frac{1}{3}$ full, again when $\frac{2}{3}$ full, and again when



TC-5552

Dusting baskets of tomatoes immediately after harvest to control drosophila oviposition.

full. For this purpose, each picker may carry a small, inexpensive puff duster. Eight to 16 ounces of dust will treat 1 ton of tomatoes.

Control at Cannery and Receiving Station

Operational Practices

Tomatoes should be processed the day they are picked. The shorter the period between harvesting and processing, the less the risk of contamination by drosophila eggs and larvae.

The importance of sanitation in the canning operation and in and around the plant cannot be over-emphasized. The presence of waste

material is an indication of carelessness; drosophila may breed by the thousands in a small quantity of such material. Wash equipment and floors frequently to prevent accumulation of tomato waste.

Keep the areas around the cannery and receiving station well inspected. You can facilitate sanitary operations if these areas are hard surfaced so they can be hosed off frequently.

Clean the waste hoppers and disposal container thoroughly each day; equip disposal containers with tight-fitting lids.

Wash the fruit carefully in a good washer; this may remove a large number of drosophila eggs.

Make certain that the inspection, sorting, and trimming lines are efficient.

Dispose of tomato refuse in a way that will reduce drosophila breeding. Very little breeding occurs in refuse that is spread thinly over a field where it will dry rapidly. Refuse loses its attractiveness to egg-laying flies after it dries on top and crusts over; however, adults may emerge from piles of refuse that attracted egg-laying flies while it was still fresh.

Use of Insecticide

Outside the canning plant.—Make the first application of insecticide before the start of the canning season. Repeat applications at about 10-day intervals during the season. Spray the outside walls of the canning plant and the outside and inside walls and ceiling of sheds used for holding unprocessed tomatoes. Spray waste hoppers and grading and receiving platforms (top and underneath). Spray to the point of runoff.

To prepare an emulsion spray for outside use, mix in each 10 gallons of water *one* of the following insecticides:

- *Diazinon*, 13 ounces of active ingredient; or
- *Naled*, 13 ounces of active ingredient; or
- *Ronnel*, 13 ounces of active ingredient.

CAUTION. Do not let these insecticides drift to unprocessed fruit.

Do not apply them while the plant is in operation, and do not apply them inside the plant.

Inside the canning plant.—For application inside the plant, use a synergized pyrethrum emulsion spray containing 0.1 percent of pyrethrins and 1 percent of piperonyl butoxide. Apply with an atomizer or mist blower at the rate of $\frac{1}{2}$ to $\frac{3}{4}$ ounce of spray to each 1,000 cubic feet.

Make inside treatments during periods when the plant is temporarily shut down and before the cleanup operation. Treat when there is little or no air movement, so the mist will remain suspended in the air for several minutes. After spraying, thoroughly wash down all equipment before resuming plant operation.

Cull tomatoes and refuse.—You may make a spray to treat piles of cull tomatoes or tomato refuse by



TC-5544

Knapsack power duster used for post-harvest treatment of tomatoes to control drosophila oviposition.



TC-5545

Disposing of tomato refuse by spreading it over a field with a tractor-drawn manure spreader.



TC-5546

Disposing of tomato refuse in a shallow pit located a few feet from a canning factory. Such piles should be treated with an insecticide to control drosophila breeding.

mixing in each 10 gallons of water one of the following insecticides:

- *Diazinon*, 6 ounces of active ingredient; or

- *Malathion*, 13 ounces of active ingredient; or

- *Ronnel*, 13 ounces of active ingredient.

Culls or refuse may also be

treated with diazinon, malathion, or ronnel, dust or granules. Apply a sufficient quantity of insecticide to give thorough coverage. Make the first application to culls and refuse immediately after it is dumped. Repeat the treatment at 5- to 7-day intervals if refuse is dumped frequently on the same pile.

PRECAUTIONS

Insecticides are poisonous. Handle them with care. Follow the directions on container labels.

Keep insecticides in closed, well-labeled containers in a dry place where they will not contaminate food or feed. Do not allow children or pets to reach them.

Wear clean, dry clothing when handling insecticides; avoid repeated or prolonged inhalation of dusts or mists, and prolonged contact with the skin. After handling insecticides, change clothing and wash hands and face before eating or smoking.



TC-5547

Cattle may safely feed on tomato refuse spread on a field if the refuse has not been treated with insecticide.

Aldrin and Diazinon can be absorbed through the skin in harmful quantities. When working with these insecticides in any form, or with concentrates of other insecticides, avoid spilling them on the skin. Keep them out of the eyes, nose, and mouth. If you spill any on the skin, wash it off at once with soap and water. If you spill it on your clothing, change the clothing immediately. If it gets in your eyes, rinse them with plenty of water for 15 minutes and get medical attention.

Do not apply aldrin, diazinon, or malathion to tomatoes within 1 day before a harvest. To protect sources of water supply, be careful not to contaminate streams, lakes, or ponds with insecticide; do not clean spraying equipment or dump excess spray material near such water. Avoid contaminating pasture grass, forage crops, or feed by drift of aldrin spray or dust. Avoid drift of insecticide into bee yards and to adjacent crops in bloom.

Keep livestock away from cull piles or refuse that has been treated with insecticide.

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